

PROJECT AUTHORIZATION NO. HWY- 2005- 23

under

MASTER AGREEMENT FOR RESEARCH AND TRAINING SERVICES BETWEEN THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION AND
NORTH CAROLINA STATE UNIVERSITY ON BEHALF OF
THE INSTITUTE FOR TRANSPORTATION RESEARCH AND EDUCATION
(Contract No. 98-1783)

Project Title: Shoreline Monitoring at Oregon Inlet Terminal Groin

Date of Project Authorization: July 1, 2004

Formal Statement of Work: See proposal

Period of Performance: 7/1/04-6/30/05

Budget Authorization: \$84,810 FY05

Property to be Furnished by the Department: None

Key Personnel: Margery Overton and John Fisher


Project Monitor:

Additional Terms and Conditions: None


IN WITNESS WHEREOF, the parties hereto have executed this Project Authorization as of
_____, 2004.


NORTH CAROLINA STATE UNIVERSITY

NORTH CAROLINA DEPARTMENT
OF TRANSPORTATION

BY: 
Principal Investigator

BY: _____

BY: 
N. C. State University

BY: 
Director of ITRE

Proposal to
NCDOT

Shoreline Monitoring at Oregon Inlet Terminal Groin

July 2004 – June 2005

Submitted by

Margery F. Overton and John S. Fisher
Department of Civil Engineering
North Carolina State University

This project has been ongoing for over 10 years. During this time the objectives have been met and the results and conclusions accepted by NCDOT and the regulatory agencies having interests in Oregon Inlet and the potential impacts of the terminal groin on the adjacent shorelines. During this period there have been a number of advancements in the technology used to analyze aerial photography. In the project period, 2003-2004, we recommended and subsequently implemented some of these advancements. These changes did not require any significant increase in costs and reduced some of the supporting photogrammetry activity currently undertaken by NCDOT.

The overall objectives of the project and the reporting requirements have remained the same. The changes implemented in 2003-2004 have improved the database associated with the project leading to better understanding of the coastal processes at the study site.

A summary of the changes implemented in 2003-2004 is given below. In addition, a copy of the proposal that has been used for the previous years is included with this new proposal. The copy of the previous proposal is also included to provide the necessary background and overall objectives of the proposed study.

2003-2004 Changes

At the start of this research program, analytical stereoplotters were used to process the aerial photography and to identify the shoreline position. Since then, NCDOT has adopted digital photogrammetry technology that includes the potential to produce digital orthophotos from the bi-monthly photography. The orthophotos document far more information about the nature of the changes occurring in the study area than we get from position of the wet/dry shoreline, including the vegetation line, overwash features, the water line, the rack line and other demarcations on the sub-aerial beach. At this point, NC DOT has continued to digitize the wet/dry line; however, we assume that this task will transition to NCSU during this proposal period.

In the 2003-2004 study period, NCDOT has thus far prepared three sets of digital orthophotos for each of the bi-monthly aerial surveys (September, December and February). As an example, the September flight, post-Hurricane Isabel, is proving to be extremely valuable in documenting storm damage beyond the calculation of change in shoreline position.

We propose that we continue with the current procedures.

(This is the Proposal that has been used in the past several years)

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BACKGROUND

The NC Division of Coastal Management (DCM) currently monitors coastal shoreline erosion rates for the purpose of permitting coastal development. The monitoring program is based in part on the Orthogonal Grid Mapping System developed by Dr. Robert Dolan, University of Virginia. The OGMS technique uses vertical aerial photography to determine the changes in the position of the high water line. This proposal is designed to provide NCDOT with a monitoring program at Oregon Inlet which will be compatible with the current DCM techniques. This will enable NCDOT to draw upon the existing database for the section of shoreline in the determination of the changes at the terminal groin and revetment built at Oregon Inlet.

OBJECTIVES

There are three primary tasks for this proposal: 1) the establishment of a comprehensive monitoring program (along a six mile section of the coast) to determine the effectiveness of the terminal groin and revetment, 2) the analysis of the data from the monitoring program and 3) the preparation of the existing data to determine an "historical rate of erosion" for the study area shoreline in conjunction with the Department of Interior representative.

DESCRIPTION OF TASKS

Monitoring Program In order for the results of the monitoring plan to be compatible with existing DCM data sets, the approach will closely parallel the OGMS method. This method uses vertical aerial photography with the shoreline position measured relative to a fixed baseline. The procedure is documented in McCollough (1988).

In brief, the OGMS shoreline monitoring method transfers the high water shoreline position to a 1:5000 base map via a zoom transfer scope. The distance from the shoreline to a fixed baseline is digitized every 50 m (transects), and a relative change in shoreline position (erosion/accretion) and the rate of this change is determined by comparison of successive dates of photography.

We propose to duplicate the fundamentals of this methodology using, where possible, appropriate advances in mapping technology. The photography will be provided by DOT on a bimonthly basis (every two months) extending from Oregon Inlet to a point six miles south. The position of the high water shoreline will be identified in the photography as the wet/dry line on the beach and digitized using currently available photogrammetric techniques appropriate to shoreline mapping. An offshore baseline will be established for the monitoring program consistent with DCM baselines. Shoreline change will be measured relative to this baseline every 150 ft.

In addition to using the OGMS method to determine the position of the ocean shoreline, the sound side shoreline will be mapped from the inlet a point one mile south. These maps will be used to determine qualitatively if the sound side shoreline adjusts after the terminal groin is constructed.

Additional land survey data provided by DOT will be used to ground truth the measurements from the aerial photography. The DOT program will include surveys twice each year, in October and April, to coincide with aerial photography missions. The survey grid will be established such that the distance between transects will be about 750

ft for the first two miles (south of the bridge), 1500 ft for miles three through five and 3000 ft for the last mile. The profiles will extend from the base of the dune to the water's edge. The high water line will be noted as part of the calibration program for the analysis of the aerial photography. Sediment samples will be collected from the mid-tide position along the profile and stored for future reference.

Data Analysis The database established with the monitoring program will be used to determine the effectiveness of the terminal groin and revetment and the need for beach nourishment to stabilize Pea Island to a point six miles south of the Bonner Bridge. Relative changes in shoreline position and rates of change will be determined for both the intervals between successive bimonthly flights, as well as cumulatively for the duration of the monitoring program.

In addition to the analysis of the bimonthly data, we will expand the DCM historical database by digitizing all the available historical aerial photography for this section of the coast. The DCM data includes 10 dates, covering the period from 1945 to 1986. We anticipate that we will be able to add about 15 additional dates, including several flights taken in the past year. The addition of these data will enable us to establish a more definitive context for the interpretation of the short-term changes which will be seen with the proposed monitoring plan. This is important in that the determination of the historical rate of erosion must take into consideration the fact that short term shoreline changes are not always reflective of longer period trends. Along these lines, a need to distinguish between the normal historical erosion rates and the erosion rates for the 1983-1988 period of hopper dredging is indicated.

Due to the spatial variability in shoreline data, some smoothing of the data may be desired. Currently, DCM uses a running average of 17 transects (50 m apart) to smooth data. We propose to look at a number of different combinations of transects for this process, and work with both DOT and the Department of Interior to select the best value for this particular application.

The data will be presented in a report every six months. The report will include an analysis of the shoreline change during the report period relative to the project historical erosion rates as well as the observed project erosion rates. These comparisons will provide the fundamental data for an assessment of the effectiveness of the terminal groin and revetment. In addition, the report will compare the shoreline changes for the reporting intervals with historical long term and shore term changes as determined from this study. This will include maps, graphs, and tabulations that include comparisons of field profile data with results of aerial photography. These data will be utilized to determine the amount of beach nourishment, if any, NCDOT will provide to restore sand lost in excess of the "historical rate of erosion" as agreed to by the FWS and NCDOT. A Department of the Interior representative will work with the PIs in the review of the data analysis.

Preparation for Meeting to Determine "Historical Erosion Rate" As discussed above, there are both long term and short term periods which must be considered when referring to erosion rate. At the time of the construction of the terminal groin, DCM used the period from 1945 to 1986 to define their long-term erosion rate for shoreline permitting. Other erosion rates can be defined, depending upon the interval of time of interest, and available photography. This project calls for a meeting to be held within 60 days after permitting to determine a historical rate of erosion. We will prepare a summary of the existing DCM data including the calculation of the erosion rates for all of the intervals currently in the DCM database. If needed, a few additional dates will be digitized to fill in any gaps that may exist in the DCM database. Included in this analysis will be both the temporal and spatial variability in the erosion rates for the study area. These data will provide a basis for the discussions leading to the eventual determination of a "historical erosion rate" for this shoreline. It should be noted that until the additional historical aerial photographs are added to the database, any conclusions regarding erosion rates may be premature.

DESCRIPTION OF THE PROJECT TEAM

The Principal Investigators have worked together on similar coastal hazard projects for many years. Their work has included studies for the Division of Coastal Management, Department of Transportation, US Marine Corps, Sea Grant and FEMA. Their research efforts have most recently been consolidated in the establishment the NCSU-Kenan Natural Hazards Mapping Lab in the Civil Engineering Department at NCSU.

REFERENCES

McCullough, Mellissa W., "Average Annual Long Term Erosion Rate Update, Methods Report", Division of Coastal Management, North Department of Natural Resources and Community Development, September 1988.